

SHORT COMMUNICATION

New records of spiders (Araneae) as hosts of terrestrial Parasitengona mites (Acari: Actinotrichida: Prostigmata)

Joanna Małol and Magdalena Felska: Institute of Biology, Department of Invertebrate Systematics and Ecology, Wrocław University of Environmental and Life Sciences, Poland. E-mail: joanna.makol@up.wroc.pl

Abstract. New data are provided on larvae of terrestrial Parasitengona mites parasitizing spiders. Larvae of Erythraeidae and Trombidiidae are recorded as parasites of spiders representing five families. Members of Philodromidae and Tetragnathidae (*Pachygnatha clercki* Sundevall 1823) are reported as hosts of Trombidiioidea for the first time. The available information indicates that some Trombidiidae have a narrow host range with affinity to spiders, whereas the Erythraeidae are more opportunistic parasites.

Keywords: Acari, parasitic larvae, Araneae

Parasitengona, one of the most diverse groups among Acari, comprise aquatic (Hydrachnidia) and terrestrial (Trombidia) species. They are known as protelean parasites, with the vast majority of larvae parasitic on arthropods or vertebrates and active postlarval forms being predaceous or pollinivorous (Wohltmann 2000).

Data on host-parasite relationships between spiders and Parasitengona mites are scattered in the literature and pertain exclusively to Trombidia. In many cases the host identification is limited to higher taxonomic ranks; i.e., order or family. Such identifications constitute a limiting factor in studies on autecology of parasitic species. Altogether, larvae of four families, Erythraeidae, Trombidiidae, Microtrombidiidae and Eutrombidiidae, including 25 named species, have been recorded as parasites of 24 named species of spiders representing 20 families (Oudemans 1897; Welbourn & Young 1988; Reillo 1989; Southcott 1991, 1999; Fain & Jocqué 1996a; Haitlinger 1996; Baker & Selden 1997; Wohltmann 1999). The aim of this work is to provide a list of new records of larvae of terrestrial Parasitengona that exploit spiders as hosts.

Spiders were collected in the Czech Republic (Ostrov u Macochy, by R. Mlejnek), Russia (Novosibirsk Region, by D.V. Logunov), France (Blois, Loir-et-Cher, by C. Hervé) and Poland (Lower Silesia, by J. Laydanowicz, D. Lupicki and J. Małol). The alcohol-preserved (70–75% ethanol) mites were fixed on microscope slides in Swan's fluid. Spiders preserved in ethanol were examined for attached Parasitengona larvae, which were then counted. An examination of attachment sites of larvae on hosts was carried out when possible. Engorged larvae were macerated in Nesbitt's fluid prior to fixation. Identification was made under a Nikon Eclipse E600 light microscope, on the basis of Southcott (1992), Małol (2005) and Laydanowicz & Małol (2010). Nomenclature of spiders follows Platnick (2010). The mites and spiders are deposited at the Department of Invertebrate Systematics and Ecology, Wrocław University of Environmental and Life Sciences, Poland, and in the collection of the Muséum national d'Histoire naturelle, Paris, France.

Larvae of two Parasitengona families, Erythraeidae (two species) and Trombidiidae (one species), were recorded as parasites of spiders from five families (Table 1). Ten host records, with specific affiliation of the spider, are new. Species of Philodromidae and *Pachygnatha clercki* have not been previously recorded as hosts of Trombidiioidea. A new host and parasite record applies to *Xysticus lanio* C.L. Koch 1835 parasitized by *Leptus mariae*. *Trombidium brevinanum* was found to parasitize spiders of four families: Theridiidae, Linyphiidae, Tetragnathidae and Philodromidae. The distribution of *L. mariae* is

extended for the Czech Republic, and that of *T. brevinanum* for Russia and France.

The number of parasites per host varied between one and five. In the case of Erythraeidae, larvae were attached to the opisthosoma and legs of the hosts, whereas Trombidiidae were attached to the prosoma and opisthosoma, with an apparent tendency to occupy places close to the pedicel. One trombidiid larva was found attached to the leg; however, due to the unengorged state, the successful parasitism of this particular specimen cannot be confirmed.

The results of the present studies confirm the opinion of Welbourn and Young (1988) that larvae of Trombidiidae occur most frequently on spiders, whereas these of Erythraeidae only seldom parasitize these hosts. The latter observation contrasts with records concerning parasitism of Parasitengona on Opiliones (Cokendolpher & Mitov 2007; Gabrys et al. 2011, this volume), of which erythraeid larvae are regarded as the most frequent parasites. Also, the larvae of Microtrombidiidae and Eutrombidiidae have been reported on spiders only infrequently (Welbourn & Young 1988; Southcott 1994; Fain & Jocqué 1996b).

Considering the number of species assigned to Trombidiidae (191), Microtrombidiidae (320), Eutrombidiidae (ca 50) and Erythraeidae (ca 300) (Małol 2007; Małol & Gabrys 2005, 2008), combined with the variety of species reported as parasites of spiders, it seems obvious that more specialized taxa can be recognized in the Trombidiidae (with respect to parasitism on spiders), than in the Erythraeidae, which seem to be more opportunistic parasites. For the time being *Trombidium brevinanum* remains the only species whose larvae exploit spiders as regular hosts and whose host spectrum seems to be restricted to arachnids (Wohltmann 1999; Gabrys et al. 2011, this volume; Judson & Małol 2011, this volume).

Leptus mariae, recorded here as a parasite of *X. lanio*, has hitherto been known to parasitize members of Coleoptera, Hemiptera and Lepidoptera (Southcott 1992; Haitlinger 2009). However, it was recently also found on Opiliones (Gabrys et al. 2011, this volume), which confirms its wider host spectrum, not being restricted to Hexapoda.

Association of some other *Leptus* spp. with particular species of spiders (Fain & Jocqué 1996a; Baker & Selden 1997; Southcott 1999) suggests a high degree of host specificity. However, this might be due to the relatively poor knowledge of infraspecific range in variability of the erythraeid larvae, which could influence the assignment of independent specific status to nominal taxa known from single specimens. Further studies, focused especially on biology, may lead to

Table 1.—List of terrestrial Parasitengona larvae parasitizing Araneae. New hosts of Parasitengona mites and/or parasites of Araneae are indicated in bold.

Parasitic mite species	Spider host	Number of larvae (attachment site)
Erythraeidae		
<i>Leptus mariae</i> Haitlinger 1987	<i>Xysticus lanio</i> C.L. Koch 1835 (Thomisidae), 1 ind.	2 (1 – opisthosoma, 1 – legs)
<i>Leptus molochinus</i> (C.L. Koch 1837); syn. <i>L. ignotus</i> (Oudemans 1903)	<i>Tetragnatha</i> sp. (Tetragnathidae), 1 juv.	1 (legs)
Trombidiidae		
<i>Trombidium brevimanum</i> (Berlese 1910)	<i>Parvateatoda lunata</i> (Clerck 1757) (Theridiidae), 1 ♀ <i>Theridion varians</i> Hahn 1833, 1 ♀ <i>Bolyphantes alticeps</i> (Sundevall 1833) (Linyphiidae), 1 ♀ <i>Diplostyla concolor</i> (Wider 1834), 1 ♀ <i>Gnathonarium dentatum</i> (Wider 1834), 2 ♀ <i>Helophora insignis</i> (Blackwall 1841), 1 ♀, 1 ♂ <i>Oedothorax retusus</i> (Westring 1851), 2 ♀ <i>Prinerigone vagans</i> (Audouin 1826), 1 ind. <i>Pachygnatha clercki</i> Sundevall 1823 (Tetragnathidae), 2 ♀ <i>Tetragnatha montana</i> Simon 1874, 1 ♀ <i>Tetragnatha</i> sp., 1 juv. Philodromidae , 1 ind.	2 (1 – prosoma, 1 – opisthosoma) 1 (opisthosoma) 1 1 2, 3 1, 1 (opisthosoma) 2 (opisthosoma), 2 1 (opisthosoma) 2 (opisthosoma), 5 (4 – opisthosoma, 1 – legs) 1 (prosoma) 1 (prosoma) 1 (prosoma)

the synonymization of species, and as a result, to a better evaluation of the degree of host specificity in *Leptus* spp.

The actual degree of infestation of spiders by Parasitengona larvae is difficult to ascertain. The Parasitengona larvae may detach quickly from the host as a result of mechanical stimuli during collection. Welbourn and Young (1988) found that 89% of the linyphiid *Ceraticheus emertoni* (O. Pickard-Cambridge 1874) were parasitized by only one larva of *Verdunella lockleii* (Welbourn and Young 1988), but the infestation was up to nine larvae per host. Adult as well as immature spiders of both sexes were parasitized. Wohltmann (1999) examined twelve spiders of three species and found four larvae to be the highest number per host. Taking all published numbers into account, the parasite load per host varies between 1 and 19, although in the majority of cases no more than four larvae were recorded (Oudemans 1912; Lawrence 1940; Michener 1946; Kawashima 1958; Parker 1965; Southcott 1966, 1986, 1991, 1994, 1999; Parker & Roberts 1974; Cokendolpher et al. 1979; Welbourn & Young 1988; Reillo 1989; Fain 1991; Fain & Jocqué 1996b; Haitlinger 1996; Baker & Selden 1997; Wohltmann 1999; present study).

Only two species of spiders, i.e. *Pachygnatha clercki* Sundevall 1823 and *Nuctenea umbratica* (Clerck 1757), are known to serve as hosts of two different Parasitengona species (André 1931; Parker 1962; Wohltmann 1999; present study); however, simultaneous parasitism has not been observed.

Attachment site preferences of parasitic larvae of Parasitengona may depend on the systematic position of the parasite. Larvae of Trombidiidae are usually found attached to the prosoma and opisthosoma of spiders. Similar site selectivity is observed in Microtrombidiidae and Eutrombidiidae. Welbourn and Young (1988) found that most eutrombidiid larvae were attached along the molt sutures of the prosoma of the host. Probably this part of exoskeleton is more accessible to penetration by the chelicerae of larvae and allows them to survive there during molting of the host.

Successful attachment to the legs of the host (i.e., leading to feeding) has only been confirmed for Erythraeidae amongst the parasitic larvae of terrestrial Parasitengona mites. Differences in site selectivity, besides the behavioral background, may result from the specific properties of the gnathosoma (Norton et al. 1988), which in Erythraeidae can be well adapted for penetration of the hard cuticle of the legs.

ACKNOWLEDGMENTS

We are grateful to Dr. Dmitri V. Logunov for collecting and identifying spiders from Russia. Our deep thanks go to Dr. Christophe Hervé, Dr. Patrick Maréchal, Dr. Vlastimil Růžička and Konrad Wiśniewski, M.Sc. for identification of spiders from France, the Czech Republic and Poland.

LITERATURE CITED

- André, M. 1931. Nouvelles observations sur la larve du *Trombidium holosericeum* Linné. Bulletin du Muséum national d'histoire naturelle, Paris 18:259–261.
- Baker, A.S. & P.A. Selden. 1997. New morphological and host data for the ectoparasitic larva of *Leptus hidakai* Kawashima (Acari, Acariformes, Erythraeidae). Systematic Parasitology 36:183–191.
- Cokendolpher, J.C., N.V. Horner & D.T. Jennings. 1979. Crab spiders of north-central Texas (Araneae: Philodromidae and Thomisidae). Journal of the Kansas Entomological Society 52: 723–724.
- Cokendolpher, J.C. & P. Mitov. 2007. Natural enemies. Pp. 339–373. In Harvestmen, The Biology of Opiliones. (R. Pinto-da-Rocha, G. Machado & G. Giribet, eds.). Harvard University Press, Cambridge, Massachusetts.
- Fain, A. 1991. Notes on mites parasitic or phoretic on Australian centipedes, spiders and scorpions. Records of the West Australian Museum 15:69–82.
- Fain, A. & R. Jocqué. 1996a. A new larva of the genus *Leptus* Latreille, 1796 (Acari: Erythraeidae) parasitic on a spider from Rwanda. International Journal of Acarology 22:101–108.
- Fain, A. & R. Jocqué. 1996b. A new genus and species of larval Eutrombidiidae Thor, 1935 (Acari: Microtrombidiidae) from an afrotrropical spider. International Journal of Acarology 22:11–16.
- Gabrys, G., M. Felska, A. Kłosińska, W. Starega & J. Makol. 2011. Harvestmen (Opiliones) as hosts of Parasitengona (Acari: Actinotrichida, Prostigmata) larvae. Journal of Arachnology 39:349–351.
- Haitlinger, R. 1996. Seven new larval species of mites (Acari, Prostigmata: Erythraeidae and Trombidiidae) from Poland. Wiadomości Parazytologiczne 42:443–460.
- Haitlinger, R. 2009. New records of mites (Acari: Prostigmata: Erythraeidae, Eutrombidiidae, Microtrombidiidae, Podothrombidiidae, Trombidiidae) from Bulgaria, Macedonia and Romania.

- Zeszyty Naukowe Uniwersytetu Przyrodniczego we Wrocławiu, *Seria Biologia i Hodowla Zwierząt* 58(572):49–60.
- Judson, M.L.L. & J. Małkol. 2011. Pseudoscorpions (Chelonethi: Neobisiidae) parasitized by mites (Acari: Trombidiiidae, Erythraeidae). *Journal of Arachnology* 39:zz-11.
- Kawashima, K. 1958. Studies on larval erythraeid mites parasitic on arthropods from Japan. (Acarina: Erythraeidae). *Kyushu Journal of Medical Science* 9:190–211.
- Lawrence, R.F. 1940. New larval forms of South African mites from arthropod hosts. *Annals of the Natal Museum* 9:401–408.
- Laydanowicz, J. & J. Małkol. 2010. Correlation of heteromorphic life instars in terrestrial Parasitengona mites and its impact on taxonomy – the case of *Leptus molochinus* (C.L. Koch, 1837) and *Leptus ignotus* (Oudemans, 1903) (Acari: Trombidiformes: Prostigmata: Erythraeidae). *Journal of Natural History* 44:669–697.
- Małkol, J. 2005. Trombidiiidae (Acari: Actinotrichida: Trombidioidea) of Poland. *Fauna Poloniae. Museum and Institute of Zoology, Polish Academy of Sciences & Natura Optima Dux Foundation, Warsaw, Volume I*[NS]:1–259.
- Małkol, J. 2007. Generic level review and phylogeny of Trombidiiidae and Podothrombiidae (Acari: Actinotrichida: Trombidioidea) of the World. *Annales Zoologici* 57:1–194.
- Małkol, J. & G. Gabryś. 2005. *Caeothrombium deharvengi* sp. nov. (Acari: Actinotrichida: Eutrombidiiidae) from Vietnam, with a proposal of Caeothrombiinae subfam. nov. *Zoologischer Anzeiger* 243:227–237.
- Małkol, J. & G. Gabryś. 2008. Trombidioidea. Pp. 145–148, 210–212. *In* *Fauna of Poland, Characteristics and Checklist of Species*. (W. Bogdanowicz, E. Chudzińska, I. Pilipiuk & E. Skibińska, eds.). Muzeum i Instytut Zoologii PAN, Warszawa.
- Michener, C.D. 1946. The taxonomy and bionomics of some Panamanian trombidiid mites (Acarina). *Annals of the Entomological Society of America* 39:349–380.
- Norton, R.A., W.C. Welbourn & R.D. Cave. 1988. First records of Erythraeidae parasitic on oribatid mites (Acari, Prostigmata: Acari, Oribatida). *Proceedings of the Entomological Society of Washington* 90:407–410.
- Oudemans, A.C. 1897. List of Dutch Acari Latr., fifth part. Trombidides Leach, with synonymical notes and other remarks and description of an apparently new, but indeed very old species of *Cheyletus*, *Ch. squamosus* De Geer. *Tijdschrift voor Entomologie* 40:117–135.
- Oudemans, A.C. 1912. Die bis jetzt bekannten Larven von Trombidiiidae und Erythraeidae mit besonderer Berücksichtigung der für den Menschen schädlichen Arten. *Zoologische Jahrbücher* 14:1–230.
- Parker, J.R. 1962. Ectoparasitic mites on spiders. *Entomologist's Monthly Magazine* 98:264.
- Parker, J.R. 1965. More records of mites as ectoparasites on spiders. *British Spider Study Group Bulletin* 25:6.
- Parker, J.R. & M.J. Roberts. 1974. Internal and external parasites of the spider *Pardosa horiensis* (Thorell) (Araneae: Lycosidae). *Bulletin of the British Arachnological Society* 3:82–84.
- Platnick, N.I. 2010. *The World Spider Catalog, Version 11.0*. American Museum of Natural History, New York. Online at <http://research.amnh.org/entomology/spiders/catalog/>.
- Reillo, P.R. 1989. Mite parasitism of the polymorphic spider, *Enoplognatha ovata* (Araneae, Theridiidae), from coastal Maine. *Journal of Arachnology* 17:246–249.
- Southcott, R.V. 1966. Revision of the genus *Charletonia* Oudemans (Acarina: Erythraeidae). *Australian Journal of Zoology* 14:687–819.
- Southcott, R.V. 1986. Studies on the taxonomy and biology of the subfamily Trombidinae (Acarina: Trombidiiidae) with a critical revision of the genera. *Australian Journal of Zoology Supplementary Series* 123:1–116.
- Southcott, R.V. 1991. A further revision of *Charletonia* (Acarina: Erythraeidae) based on larvae, protonymphs and deutonymphs. *Invertebrate Taxonomy* 5:61–131.
- Southcott, R.V. 1992. Revision of the larvae of *Leptus* Latreille (Acarina, Erythraeidae) of Europe and North America, with descriptions of post-larval instars. *Zoological Journal of the Linnean Society* 105:1–153.
- Southcott, R.V. 1994. Revision of the larvae of the Microtrombidinae (Acarina: Microtrombidiiidae) with notes on life histories. *Zoologica* 144:1–155.
- Southcott, R.V. 1999. Larvae of *Leptus* (Acarina: Erythraeidae), free-living or ectoparasitic on arachnids and lower insects of Australia and Papua New Guinea, with description of reared post-larval instars. *Zoological Journal of the Linnean Society* 127:113–276.
- Welbourn, W.C. & O.P. Young. 1988. Mites parasitic on spiders, with a description of a new species of *Eutrombidium* (Acari, Eutrombidiiidae). *Journal of Arachnology* 16:373–385.
- Wohltmann, A. 1999. On the biology of *Trombidium brevimannum* (Berlese, 1910) (Acari: Prostigmata: Parasitengonae: Trombididae) with a redescription of all active instars. *Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut* 96:159–170.
- Wohltmann, A. 2000. The evolution of life histories in Parasitengona (Acari: Prostigmata). *Acarologia* 41:145–204.

Manuscript received 29 September 2010, revised 31 January 2011.